

Mineral Resource

Arizona Mining Review—2005

Nyal Niemuth, Chief Mining Engineer

Record copper and molybdenum prices and strong demand for industrial mineral commodities resulted in a 44 percent increase in the value of Arizona's mineral production. The value of Arizona's copper production rose to \$2.64 billion. Arizona regained its number one ranking nationally by value of non-fuel mineral production, according to preliminary data released by the USGS. The value of non-fuel mineral production for the year was \$4.7 billion. Arizona produced over 60 percent of the nation's copper and was also a leading producer of molybdenum, sand and gravel, and gemstones. Property acquisition and exploration for copper and uranium increased significantly.

Value of Arizona Mineral Production¹

Commodity	2003	2004 ⁴	2005 ⁴
Copper	1,390,000,000	2,130,000,000	2,600,000,000
Gemstone	1,440,000	1,450,000	na
S&G	340,000,000	430,000,000	na
Crushed stone	49,100,000	57,200,000	na
Combined values ²	394,000,000	710,000,000	na
Subtotal from USGS	2,180,000,000	3,330,000,000	4,700,000,000
Coal ³	289,000,000	312,000,000	300,000,000
Total	2,469,000,000	3,462,000,000	5,000,000,000

1) US Geological Survey (USGS) data except as noted; totals rounded to nearest million

2) Includes cement, clay, gold, gypsum, lime, molybdenum, perlite, salt, sand and gravel (industrial), silver, stone (dimension), zeolites, and values shown as na

3) Arizona Department of Mines and Mineral Resources for coal

4) Unpublished USGS data, subject to change; official preliminary 2005 data. Final 2004 data will be published in the Arizona Chapter of the USGS Mineral Yearbook, Area Reports: Domestic 2004, volume II.

Copper and Molybdenum

The copper price shot up dramatically in 2005, increasing \$.40 per pound, a 29.5 percent increase. The US producer cathode price averaged \$1.73, a record level. The value of by-product molybdenum recovered at the Bagdad and Sierrita mines also increased dramatically. The mean annual Molybdenum Dealer Oxide price reported by Platts Metals Week doubled, rising from \$16.41 in 2004 to \$31.10 per pound. The metal contributed significantly to the dramatic rise in the value of the state's mineral production. Despite the rise in

copper prices and by-product credits, shortages of tires, pit flooding, and labor strikes resulted in a 4.4 percent decline in copper production for 2005.

Phelps Dodge

Five Phelps Dodge mines accounted for 78 percent of Arizona's copper production. They also helped the company post a record annual net income of more than \$1.6 billion for 2005. The company announced that it would establish a global environmental reclamation and remediation fund and make an initial contribution of \$400 million to it in 2006.

The Morenci mine is the largest copper-producing complex in the U.S. In 2005 it produced 800 million pounds of copper via leaching. That was more than 52 percent of Arizona's total.

In June, Phelps Dodge's board approved spending \$210 million at Morenci to construct the first commercial-scale concentrate leach direct electrowinning facility, and restart the flotation mill. Production is expected to begin mid-2007 with a capacity of 150 million pounds per year. The concentrator is expected to resume production during 2006 from chalcopyrite ore from the Western Copper, Garfield, and other mine areas, and produce 32,000 tons of concentrate.

When completed, the pressure leaching plant will use medium-temperature technology (160° C) to produce 150 million pounds annually. This process generates significantly less sulfuric acid, but requires less oxygen. It was recently tested successfully for seven months at the demonstration pressure leach plant at Bagdad. That plant has now reverted to the high temperature (225° C) process so the Bagdad mine can take advantage of the greater amount of acid required for its oxide leaching operations. The technology used is proprietary and is shared under a development agreement between Placer Dome (acquired by Barrick) and Phelps Dodge.

Phelps Dodge's byproduct molybdenum production totaled 29.9 million pounds, largely from the Sierrita and Bagdad mines. Both benefited from the doubling in price of molybdenum oxide. Calling molybdenum a byproduct was the wrong phrase this year as skyrocketing molybdenum prices reversed the role with copper and made Sierrita the top revenue producer, outperforming Morenci in earnings for Phelps Dodge for part of the year!

The electrolytic refinery at Miami was permanently closed in 2005. Smelting continued there along with residual leaching operations at the Miami mine.

The Safford project received tentative board approval of \$550 million to build the two new open pits, Dos Pobres and San Juan, and the heap leach SX-EW facility. Leach production is anticipated to begin in late 2008 at an annual rate of 240 million pounds per year. An 18-year life is expected for the deposits combined 538 million tons that contain 0.37 percent copper.

Plans are to construct a plant to produce acid from elemental sulfur in the Safford area. The development is expected to have a major positive impact on the local economy. The project will generate 1000 construction and

500 permanent jobs. A major drilling program, rumored to total 600,000 feet, was getting underway at year's end on two deposits located within 4 miles of Dos Pobres.

Safford is now also the home of the company's Process Technology Center. In addition to its hydrometallurgical research capabilities, it will provide a high quality and cost effective central analytical facility replacing labs located at Arizona and New Mexico mines

Phelps Dodge's Tohono mine restarted operation in the fourth quarter of 2004 to recover copper from existing leach piles. Cathode production for 2005 totaled 5 million pounds. Mineralized material reported for the Tohono deposit includes 276 million tons milling material grading 0.70 percent and 404 million tons leachable material grading 0.63 percent.

Asarco

Asarco, Arizona's second largest producer, struggled through a very difficult year. During the first half of the year things proceeded relatively well, as production from Ray, Mission, and Silver Bell totaled 105 million pounds, an increase of 25 percent compared to 2004. This increase occurred despite the Ray mine suffering from flooding caused by heavy winter rains and the Hayden smelter being closed for maintenance for 50 days. Asarco moved its headquarters to Tucson from Phoenix in April and announced it had become a limited liability company.

Events became less favorable after that. In July the union workforce went out for what would become a lengthy strike. Production, continued by salaried personnel and a limited number of picket crossers, fell to roughly half of capacity.

On August 9, Asarco LLC filed for Chapter 11 Bankruptcy in Federal Court in Texas. The resulting deconsolidation provided a debt reduction of \$443 million for Asarco's owner Grupo Mexico. The strike ended in November after limited replacement worker hiring forced the company to abandon the concessions it had been seeking. Production from the three mines for the year totaled 311 million pounds of copper, a decline of 9.5 percent largely due to lost production during the strike.

Other Copper Companies

Resolution Copper Company announced that it plans to spend \$250 million during the current phase of exploration and development on their giant Resolution Copper project located near Superior in Pinal County. Its efforts include the introduction of the Southeast Arizona Land Exchange and Conservation Act of 2005 in Congress.

Surface drilling resumed in February 2005 and is continuing as of March 2006. Deepening of the number 9 and sinking the number 10 shaft is scheduled to begin during 2006.

Mercator Minerals made significant strides, increasing both copper production and resources at Mineral Park. Additions to the SX-EW plant allowed it to double production and achieve a capacity of 11 million pounds per year. Announced reserves for the property are 77 million tons grading 0.23 percent copper, while measured resources total 345 million tons at a copper equivalent grade of 0.41 percent using copper at \$1/pound and molybdenum \$7.00/pound.

Mercator replaced its mining contractor by acquiring its own truck and shovel fleet. The company purchased a 20,000-tpd mill from Asarco. If a feasibility study is positive, the mine may resume concentrating copper and also molybdenum. That would be something it hasn't done in 25 years.

After a joint venture with BHP-Billiton failed to develop, Cambior decided to put the Carlota oxide copper property, along with equipment it had acquired, including ten used 190-ton trucks, 1 used P&H 2800 shovel, and a solvent extraction plant up for auction. The winning bid was \$37.5 million in cash and gold by Quadra Mining. Terms required \$15 million cash to be paid at closing and eight quarterly payments of 6,250 ounces of gold to be made beginning in March 31, 2006. Quadra Mining plans to begin construction in mid-2006 and expects production to occur in 2007.

Based on a September 2005 NI43-101 technical report, the Carlota project anticipates an 11-year life with a production of 66 million pounds per year.

Augusta Resources entered into an agreement to acquire the Rosemont copper deposit located south of Tucson. The purchase price was \$20.8 million to be paid over three years. Previous drilling by Anaconda/AMAX and Asarco had identified 400 million tons of copper/molybdenum skarn-related mineralization in four deposits that contain approximately 5 billion pounds of copper. A 30,000-foot drill program to produce a NI43-101 compliant resource estimate has been completed.

General Minerals advanced three copper exploration targets. It optioned the Monitor property located northeast

of the Ray mine to Teck Cominco who began a drilling program in November to test shallow and deep copper and silver targets. Teck Cominco also optioned the Markham Wash geophysical prospect located in the Safford District in early 2006. BHP-Billiton optioned the Dagoon project and planned a drilling project where General Minerals had identified a 3 square km geophysical target. Redhawk Resources acquired a large land position totaling 7 square miles in the Copper Creek district that contains high level breccia pipes as well as porphyry style mineralization. The company is logging and re-logging more than 400,000 feet from previous drilling. It is also evaluating resources previously announced by AMT for three pipes to determine exploration and mining plans.

Southern Silver acquired an option in the Tombstone project, a multi-target porphyry skarn prospect 5 miles southwest of the town of Tombstone.

Nord Resources completed a geophysical IP survey that identified an anomaly attributed to sulfide mineralization at depth at Coyote Springs the Safford District.

Gold

Precious metals also benefited from increased prices. Gold broke the \$500 per ounce for the first time in 18 years and later reached a 25-year high of \$535. American Bonanza completed a 40,000-meter drill program at the Copperstone gold project in western Arizona. In early 2006 it announced 334,000 ounces gold contained in a million ton underground resource. The work also identified additional targets under aeolian sand cover that are planned to be drill tested in 2006. Also receiving serious exploration drilling were the Mildred Peak/Jupiter project in Pima County by Golden Arch Resources and the Golden Eagle/Bonanza in La Paz County by Terraco Gold. Galaxy Minerals reported acquiring a small mill for its Yellow Jacket mine in Santa Cruz County.

Uranium

Acquisition of uranium properties surged during 2005 with more than 12 companies reporting acquisitions or claim staking targets. The number of State Land prospecting leases issued for uranium increased from 2 to 16 during fiscal year 2005. This activity paralleled the impressive performance of spot prices that reached \$36.25 per pound U₃O₈ at year's end.

Most activity occurred on the Arizona Strip and Coconino Plateau related to high-grade uranium mineralized solution collapse breccia pipes. International Uranium reported it was considering reopening its Arizona 1 mine, a process it reportedly could achieve within 18 months. Ore would be processed at its Blanding, Utah mill. US Energy and Uranium Power Corp. announced a drill program that began in November on the Star claim group located near the Arizona 1 deposit where it reports 23 pipes may occur. The 40-hole project is designed to verify solution collapse features. Where favorable structures are confirmed, a second phase of deeper drill will follow. U.S. Energy owns the Shootaring Canyon mill in Garfield County, Utah through its subsidiary Plateau Resources. Quincy Energy drilled a 1,900-foot hole in the Rose Pipe previously identified as a mineralized pipe by Energy Fuels.

Ashworth Exploration conducted exploration sampling and drilling on three properties under option to Golden Patriot and Rodinia Minerals in Gila County. Concentric Energy and other companies pursued deposits hosted in the Tertiary Chapin Wash Formation in Yavapai and Mohave Counties.

Coal

In December, Peabody closed the Black Mesa strip mine after a supply contract to its sole customer expired. The shutdown was directly related to Southern California Edison's decision not to seek California Public Utilities Commission approval to install sulfate scrubbers. Their installation in the Mohave Generating Station was required by a 1999 EPA consent decree to be completed before 2006.

The Black Mesa mine typically produced 4.5 million tons of coal annually and had been delivering coal to the power plant since 1970. The closure impacts both Navajo and Hopi tribes, but the loss to the Hopis will be especially difficult as the coal royalties represent about a third of the tribal government revenue.

The Kayenta mine, which supplies the Navajo power plant at Page with eight million tons of coal annually via automated unit trains, continues normal operations.

Industrial Minerals

Another international aggregate producer La Farge North America, entered the Phoenix metropolitan sand and gravel market by acquisition in the southwest valley,

a likely large future growth area. Interest in additional sites for exploration and purchase were reported.

U.S. major Vulcan Materials continued its expansion in Arizona by acquiring New West Materials Co. LLC whose assets included three aggregate and asphalt facilities in the Phoenix area and two aggregate and asphalt facilities in Tucson. The Tucson operations are Vulcan's first in that market.

Government News

The Aggregate Mine Land Reclamation bill became law in May. It applies to aggregate operations started after April 1, 1997, of more than five acres of private land. Existing operations must submit plans to the State Mine Inspector by January 1, 2007 and after that date new mines require approval before beginning to operate. The bill requires financial assurance mechanisms and public community notification. It limits authority of flood control districts to regulating stability and capacity of floodplains.

The Maricopa County Board of Supervisors modified Rule 316, *Nonmetallic Mineral Processing*, that tightened dust emissions. It requires pavement of dirt roads on sites, installation of rumble strips, wheel cleaners, and street sweepers.

Comments for the Environmental Assessment for the Drake Quarry located on Prescott Forest Service lands were due in December. Construction of the cement plant on adjacent private land may begin in the second half of 2006. The U.S. Supreme Court refused to hear the 9th Circuit Court of Appeals decision regarding the State of Arizona's refusal to buy aggregate materials from Dale McKinnon's private property known as Woodruff Butte. The Hopi, Navajo, and Zuni Indians have declared the butte a sacred site. McKinnon claimed his rights were violated by the State's not issuing commercial source approval, thus prohibiting sale of his aggregate materials to State projects.

For more details of the geology and distribution of metallic commodities discussed here, download the Arizona Department of Mines and Mineral Resource's new OFR23-06 Arizona's Metallic Resources - Trends and Opportunities posted at: www.mines.az.gov.

From the Director's Desk

by Dr. Madan M. Singh

The Role of Minerals in Arizona's Economy

A recent report by Marshall J. Vest of the Eller School of Management at the University of Arizona projects that the State will add 8.5 million people in the next three decades, and it may become the fifth most populated state in the country. He emphasizes the role of water and transportation will be important to accommodate this growth.

Other studies indicate the possible shortages of water and the need to generate more energy – sometimes referred to as the water-energy nexus. In addition, These reports emphasize the need for more infrastructure. However, the fact that the infrastructure – roads, buildings, houses, manufacturing and power plants – all need minerals is underplayed or ignored. This is especially disconcerting since Arizona is the No. 1 nonfuel mining state in the nation, and the territory was initially developed because the early settlers were attracted by its mineral wealth.

In order to construct the infrastructure, sand and gravel, aggregate, copper, iron ore, and other minerals need to be mined. Cement, electrical wires, nails, pipe – all require mined materials. The State is already experiencing shortages of cement and other construction materials. Even if energy is not produced from coal or hydrocarbons, metals and other minerals are required for solar and wind energy generation. It may be stated, however, that coal and hydrocarbons in some form or another will still be required for a major portion of the electricity generation in the foreseeable future. Montana is vying for a coal-to-liquids plant. A mine-mouth, coal-fired power plant is being planned across the state-line in New Mexico on Navajo land. The Salt River Project (SRP) is attempting to revive the Mohave Generating Station in Nevada. Nuclear energy is destined to play a more significant role in the forthcoming years; Arizona already has the largest such power plant in the nation. Arizona has significant deposits of uranium, which are planned to start being mined soon.

Many towns are opposed to having mines or quarries in their vicinity, even though this raises the cost of construction. A recent example is the rural area near Vail, which is fighting the location of a new limestone mine. The specter of noise, dust, traffic and aesthetics seem to be the main concerns, although mine operators are quite sensitive to the needs of the community, and generally have liaison committees working with them.

Continued on page 6

Museum News

by Susan Celestian, Curator

I would like to invite everyone to visit the Museum Gift Shop, even if you have done so in the past. Ann Baker (Gift Shop Manager) and Laurette Kennedy (Tour Guide) are doing a fabulous job of stocking the shelves with wonderful things to buy. And remember, the proceeds from gift shop sales support the part-time salaries and educational activities by the Museum staff.

Ann has a gift when it comes to knowing what people like, has a good eye for quality, and has a subtle, yet powerful bargaining style. From India to Brazil, the dealers know her and offer her low prices and high-grading privileges. And she has a great eye for presentation – a new case filled with turquoise is a real eye-popper. She has just returned from a short buying trip, and is now resting up for the big shopping spree in January and February. Shopping, stringing beautiful necklaces/earrings, preparing and pricing minerals, stocking the shelves, gluing rocks and minerals on the cards we sell, coordinating the Treasure Bags (and that is a LOT of work!), planning ahead for Family Day bargains and kids' activities, and generally helping out – Ann spends two days in the Museum and donates many hours at home.

Laurette is busy as a bee buying books. In fact, she has been so busy that we had to buy an additional bookshelf, too. She has significantly enhanced our children's section. As a retired school teacher, she has her eye out for books that will be great additions to Arizona's classrooms. And she maintains a terrific selection of books that appeal to the gold miners, rockhounds and students of Arizona's mining history; plus lately she has been branching out with coffee table books, cookbooks, and books of general interest. Last summer she started a summer book reading program for children, and as part of one of those sessions had the author of one of the books we sell, come in and read a selection and talk about how he writes. She too has a great eye for presentation and is quite a saleswoman.

So come on in and say "Hi" to the gang. Perhaps you could do some holiday shopping while you are here!

It should be borne in mind that transportation of construction materials from a distant location not only increases costs, but is worse for the environment because of longer hauls. Traffic on the highways is also adversely affected.

Minnesota (Section 84.94, 1984), Washington State (Growth Management Act, 1990), Tooele County Utah (Chapter 7 – Mining, Quarry, Sand and Gravel Extraction Zone) have recognized the conflict and already passed protective legislation for mineral production. Colorado (H.B 1529, 1973) and California (Surface Mining and Reclamation Act, 1975) tried to do the same, although not very effectively.

In 2005 the minerals industry contributed nearly \$10 billion to Arizona's economy, including both the direct and indirect components. The taxes to the State exceeded \$26 million in fiscal year 2005. In addition, the industry contributes to various counties and school districts in many forms.

California has an estimated reserve of 81 billion tons of aggregate reserves (that could last 350 years at the present rate of consumption), but instead has opted to import aggregate from British Columbia. The cost of transportation from remote locations is often not comprehended by the public. Since nearly half the aggregate is used for government projects, the public absorbs that cost as taxes. Let us prevent Arizona from following that path.

BOARD OF GOVERNORS

Samuel O. Aubrey -
Chairman - Sun Lakes

**Dr. Raymond
Grant -**
Vice Chairman -
Chandler

P.K. Rana Medhi -
Member - Casa
Grande

**Dr. Patrick F.
O'Hara**
Member - Prescott

Dr. Mary M. Poulton
Member - Tucson

STAFF

Dr. Madan M. Singh -
Director

Nyal Niemuth - Chief
Mining Engineer

Diane Bain - Public
Information Officer

Jacqueline Hall -
Administrative Assistant

Tina Mendoza -
Clerk Typist

Susan Celestian -
Curator

TOUR GUIDES

Liz Anderson

Ann Baker

Shirley Coté

Doug Duffy

Joanne Hesterman

Laurette Kennnedy

Alice Rosenfeld



Arizona Department of Mines & Mineral Resources
1502 West Washington
Phoenix, AZ 85007

Address Correction Requested